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J. F. Whitson

32

A

TABULAR DISTRIBUTION

OF

THE MORE COMMONLY OCCURRING MINERALS:

BY MEANS OF WHICH THEY MAY BE EASILY RECOGNISED.

DRAWN UP FOR THE USE OF HIS CLASSES

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ADVERTISEMENT.

As THIS little work is intended to be used by the Pupil almost at the commencement of his Mineralogical studies, the employment of Crystallography and Chemical Notation has been purposely avoided. The more advanced Student is recommended, however, to write in the margin against each Species the Crystallographic System to which it belongs, and its Chemical Formula. He will not find his labour thrown away.

The slight preliminary knowledge requisite for the application of this method to the discrimination of Minerals, is supposed to have been gained by the Pupil during the few Lectures which precede its introduction to the class.

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I.

MINERALS OF A METALLIC ASPECT.

A.—HARDNESS SUFFICIENT TO SCRATCH ORDINARY WINDOW GLASS. (H = 5 OR MORE.)

§ 1.—*COLOUR, TIN WHITE OR SILVER-WHITE.*

Smaltine (arsenide of cobalt).—Tin-white; G., 6·3-7·3; in small octahedrons, &c., and in arborescent and other forms. B., strong alliaceous fumes; with borax, after roasting, a fine blue glass.

Cobaltine (sulph-arsenide of cobalt).—Reddish silver-white; G., 6·1-6·3. Otherwise like Smaltine, but yielding an alkaline sulphide with carb. soda before the blowpipe.

Mispickel (sulph-arsenide of iron).—Tin-white; G., 6·0-6·3; massive or in small aggregated rhombic prisms, sometimes with a yellow or blueish tarnish. B., alliaceous fumes; with carb. soda, an alkaline sulphide.

§ 2.—*COLOUR, YELLOW OR PALE COPPER-RED.*

Mispickel.—Sometimes tarnished yellow. See Sec. 1.

Iron Pyrites (bi-sulphide of iron).—Brass yellow; G., 4·9-5·1; massive, and in cubes, pentag. dodecahedrons, &c. B., sulphur fumes and reaction.

Radiated Pyrites (bi-sulphide of iron).—Light yellow; in globular radiated masses, or small rhombic prisms, &c. Otherwise like common pyrites.

Nickeline (arsenide of nickel).—Pale copper-red; massive; G., 7·5-7·7. B., strong alliaceous fumes.

§ 3.—*COLOUR, BLACK, STEEL-GREY, OR BROWN.*

The minerals of this section yield no fumes before the blow-pipe; and are either infusible, or fusible only in the R.F. The lustre is very generally sub-metallic.

(*a*) STREAK-POWDER, BLACK.

Magnetic Iron Ore (magnetic oxide of iron).—Black; G., 4·9-5·2; massive, or in octahedrons, &c.; strongly magnetic.

Iserine (titaniferous iron oxide).—Black; in octahedrons, rolled pebbles, river sand, &c.; magnetic. B., with mic. salt in R. F., a deep-red glass.

Ilmenite (titaniferous iron oxide).—Black; G., 4·6-5·3; in flat, many-facetted, rhombohedral crystals, massive, &c.; generally magnetic. B., like *Iserine*.

Psilomelane (hydrated ox. of manganese).—Black; G., 3·7-4·4; in botryoidal masses, &c. B., with carb. soda, a turquoise enamel; yields water in the bulb-tube.

(*b*) STREAK POWDER, DARK BROWN.

Ilmenite.—Sk. generally black. See above.

Franklinite (oxides of iron, manganese, and zinc).—Black; G., 5·0-5·2; massive, in rhombic dodecahedrons, &c.; slightly magnetic. B., with carb. soda, a turquoise enamel.

Chromolite (chromite of iron oxide).—Black; G., 4·4-4·6; massive, and like *Franklinite;* sometimes feebly magnetic. B., with mic. salt in R. F., a fine green glass.

Psilomelane.—See above. Sk. brownish-black.

Wolfram.—Sk. reddish-brown. See below.

(*c*) STREAK-POWDER, DULL-RED.

Specular Iron (sesquioxide of iron).—Iron-black, steel-grey; G., 5·0-5·3; in flat rhombohedral crystals, lamellar, scaly, fibrous, and globular masses; sometimes slightly magnetic. B., becomes magnetic, and fuses in the R. F.

Wolfram (titaniferous iron and manganese oxides).—Dark-brown; sk. reddish-brown; G., 7·1-7·6; in oblique prisms, or masses possessing a lamellar, granular, or divergent-prismatic structure; sometimes feebly magnetic. B., fuses; the surface

of the globule generally shoots into little crystals; with carb. soda, a turquoise enamel.

(*d*) STREAK-POWDER, BROWNISH-YELLOW.

Brown Iron Ore (hydrated sesquioxide of iron).—Dark-brown; rarely with metallic lustre; G., under 4; in fibrous botryoidal masses; yields water in the bulb-tube.

B.—HARDNESS NOT SUFFICIENT TO SCRATCH GLASS. (H. UNDER 5·0.)

§ 1.—*COLOUR, SILVER OR TIN-WHITE.*

(*a*) VOLATILIZABLE WHOLLY OR IN PART BEFORE THE BLOWPIPE.

Native Mercury.—In little tin-white and fluid globules, disseminated through the gangue.

Native Amalgam (mercurial silver).—Silver-white; H., 3-3·5; G., 11-14; in rhombic dodecahedrons and small masses with conchoidal fracture. B., partly vol., a globule of silver remaining.

Native Bismuth.—Reddish silver-white; H., 2-2·5; G., 9·5-10; in small lamellar masses. B., vol., depositing a yellow crust (of oxide) on the charcoal.

Native Arsenic.—Tin-white, tarnishing dark grey; H., 3·5; G., 5·6-6; chiefly in globular or botryoidal masses, with concentric lamellar structure. Gives out a garlic-like odour when struck by the hammer. B., vol., with alliaceous odour, and white deposit on the charcoal.

(*b*) NOT VOLATILIZABLE; FUSIBLE.

Native Silver.—Silver-white, tarnishing black. H., 2·5-3; G., 10-11; in filiform and arborescent shapes, small and closely aggregated cubes, &c. Malleable.

(*c*) NEITHER VOLATILIZABLE NOR FUSIBLE.

Native Platinum.—Tin-white to pale steel-grey. H., 4-4·5; G., 16-19; chiefly in little grains and rolled masses.

§ 2.—*COLOUR, YELLOW, RED, OR BROWNISH.*

(*a*) YIELDING FUMES BEFORE THE BLOWPIPE, OR ODOUR OF BRIMSTONE.

Copper Pyrites (sulphide of copper and iron).—Rich yellow; sk. blackish-green; H., 3·5-4; G., 4·1-4·3; in dimetric tetrahedrons, amorphous and botryoidal masses. B., fuses; the globule magnetic. Flame coloured green. It is the principal "ore" of copper.

Purple Copper Pyrites (sulphur, copper, iron).—Reddish, but generally tarnished blue, &c., through the entire mass; sk. black; H., 3; G., 4·9-5·1; usually massive. B., like copper pyrites.

Magnetic Iron Pyrites (sulphur, iron).—Brown or brownish-yellow; sk. black; usually massive; H., 3·5-4·5; G., 4·4-4·7; slightly magnetic, sometimes with polarity.

These three minerals yield alkaline sulphides with carb. soda before the blowpipe.

Native Bismuth.—Sometimes tarnished yellow. B., volatilizable, with yellow incrustation.—See Sec. 1.

(*b*) FUSIBLE, BUT NOT YIELDING FUMES. MALLEABLE.

Native Gold.—Fine rich yellow; chiefly in grains, filiform and foliated masses; H., 2·5-3; G., 16-19·5.

Native Copper.—Copper red; in small cubes, octahedrons, &c.; amorphous, filiform, and arborescent; H., 3; G., 8·5-9. B., flame coloured green; fine green-blue glass in O. F. with borax.

§ 3.—*COLOUR, BLACK OR METALLIC-GREY. INFUSIBLE.*

(*a*) YIELDING TO THE NAIL.

Graphite or *Plumbago* (carbon, more or less pure).—Black, sk. black; feels greasy; amorphous, or in small foliated masses. G., 1·9-2·2.

Molybdenite (sulphide of molybdenum).—Black or lead-grey; sk. black on paper, greenish on smooth porcelain or polished bodies; in hexagonal tables or foliated masses; G., 4·4-4·8; greasy feel. B., slowly vol.; flame coloured pale green.

Pyrolusite (ox. of manganese).—Black or iron grey; soils; usually in radiating fibrous masses; G., 4·8-5. B., with carb. soda, a turquoise enamel. This mineral is the principal "ore" of manganese.

(*b*) TOO HARD TO BE SCRATCHED BY THE NAIL.

Manganite (hydrated ox. of manganese).—Steel-grey to black; sk. dark reddish-brown; in prismatic crystals, fibrous and granular masses; H., 4; G., 4·3-4·4. B., with carb. soda, a turquoise enamel.

Native Iron.—Steel-grey or iron-grey; ductile; H., 4·5; G., 7·3-7·8; strongly magnetic.

Native Platinum.—Light steel-grey to tin-white; G., over 16.—See Sec. 1.

§ 4.—*COLOUR, BLACK OR METALLIC-GREY. FUSIBLE.*

(*a*) B. NO INCRUSTATION ON THE CHARCOAL.

Native Silver.—Sometimes tarnished black.—See Sec. 1.

Argyrose or *Silver Glance* (sulphide of silver).—Blackish lead-grey; malleable; in filiform masses, aggregated cubes, &c.; H., 2-2·5; G., 7·2-7·4. B., sulphur fumes and reaction.

Chalkosine or *Copper Glance* (sulphide of copper).—Blackish lead-grey, sometimes with a variegated tarnish; massive and in short six-sided pyramids, &c.; H., 2·5-3; G., 5·5-5.8. B., sulphur fumes; flame coloured green. A valuable copper ore.

(*b*) A YELLOW INCRUSTATION ON THE CHARCOAL.

Galena or *Lead Glance* (sulphide of lead).—Lead-grey; in cubes, cubo-octahedrons, &c., or massive; breaking easily into rectangular fragments; H., 2·5; G., 7·4-7·6. B., decrepitates, and is reduced. It is the chief "ore" of lead.

Bournonite (antimony, sulphur, lead, copper).—Dark-steel or lead-grey, massive, fibrous, or in small prismatic crystals; H., 2·5-3; G., 5·7-5·8. B., decrepitates, colours the flame green; a white incrustation also takes place on the support; copper reaction with borax.

Jamesonite (sulphur, antimony, lead).—Steel-grey; chiefly in columnar masses, with very perfect transverse cleavage; H., 2-2·5; G., 5·5-5·8. B., decrepitates, forms also a white incrustation on the support.

Zinkenite (sulphur, antimony, lead).—Steel-grey; chiefly in fibrous masses on quartz; H., 3-3·5; G., 5·3-5·4. B., like Jamesonite.

Bismuthine (sulphur, bismuth).—Lead-grey or tin-white; chiefly in fibrous or acicular forms; H., 2-2·5; G., 6·5-6·6. Fuses in the flame of a candle. Entirely vol.

(*c*) A WHITE INCRUSTATION ON THE CHARCOAL.

Stibine or *Antimony Glance* (sulphur, antimony).—Light lead-grey, often with a black or iridescent tarnish, fibrous, columnar, massive, or in small prismatic crystals; H., 2; G., 4·5-4·7. Fuses in the flame of a candle. Entirely vol. It is the commercial "ore" of antimony.

Panabase or *Grey Copper* (sulph., antim., copper, zinc, &c.)—Steel-grey or iron-black; in small modified tetrahedrons, or massive; H., 3-4; G., 4·5-5·2. B., copious white fumes; green flame; copper reaction with borax.

Red Silver Ore; certain varieties.—Iron-black, red in thin pieces; sk. red.—See p. 28.

II.

MINERALS OF A NON-METALLIC ASPECT.

A.—HARDNESS SUFFICIENT TO SCRATCH ORDINARY WINDOW GLASS.

§ 1.—*FUSIBLE BEFORE THE BLOWPIPE.*

(*a*) YIELDING WATER IN THE BULB-TUBE.

These minerals are almost invariably associated with trap or basaltic rocks. They are all hydrous silicates, mostly of alumina, with lime or an alkali. With the exception of Prehnite, they scratch glass but faintly. They have no employment in the arts.

Mesotype or *Natrolite.*—Colourless, yellow, &c.; chiefly in fibrous radiated masses, and acicular crystals; H., 5-5·5; G., 2·17-2·27. B., fuses quietly.

Analcime.—Colourless, pale red, &c.; generally in modified cubes or trapezohedrons; H., 5·5; G., 2·1-2·3. B., fuses quietly.

Thomsonite.—Colourless, &c.; fibrous, acicular-prismatic; H., 5-5·5; G., 2·3-2·4. B., intumesces.

Apophyllite.—Colourless, &c.; in square pyramids and prisms, with truncated angles; sometimes tabular, rarely massive; H., 4·5-5; G., 2·3-2·4. B., exfoliates, and fuses with bubbling.

Prehnite.—Colourless, light green, &c.; in radiated fibrous and globular masses, and in closely aggregated flat prismatic crystals; H., 6-6·5; G., 2·8-3·0. B., fuses with continued bubbling.

Datolite (silico-borate of lime).—Greenish, &c.; massive, and in aggregated monoclinic forms; H., 5-5·5; G., 2·9-3. B., fuses with bubbling, the flame coloured green.

(*b*) NOT YIELDING WATER—IMPARTING A GREEN TINT TO THE BLOWPIPE FLAME.

Boracite (borate of magnesia).—Colourless, greenish, &c.; generally in small cubes, with the alternate angles truncated, imbedded in anhydrite or gypsum; rarely massive; H., 7; G., 2·9-3. B., fuses with bubbling. Pyro-electric.

Axinite (a silicate of alumina, lime, &c., containing boracic acid).—Clove-brown, greyish, &c.; in flat sharp-edge (triclinic) crystals; H., 6·5-7; G., 3·0-3·3. Fuses with bubbling; the glass becomes black in the O. F. Pyro-electric.

(*c*) IMPARTING A RED TINT TO THE BLOWPIPE.

(Silicates of alumina and lithia.)

Spodumene or *Triphane*.—Greenish, greyish, &c.; in lamellar masses; H., 6·5-7; G., 3·1-3·2. B., curls up very much, and intumesces before fusion.

Petalite.—Colourless, reddish, &c; in lamellar masses; H., 6-6·5; G., 2·4-2·5. B., fuses with bubbling.

(*d*) NOT EXHIBITING THE ABOVE REACTIONS. SPECIFIC GRAVITY UNDER 3·0.

(Silicates of alumina, with lime, soda, potash, &c.)

Nepheline.—Colourless, greenish, brown, &c; in hexagonal prisms, or massive, chiefly in lava; H., 5·5-6; G., 2·5-2·7.

Elæolite.—Green, blueish-red, &c.; strong resinous or greasy lustre; chiefly massive; H., 5·5; G., 2·5-2·7. Fuses easily.

Sodalite.—Colourless, greenish, &c.; in vitreous masses and rhombic dodecahedrons; H., 5·5-6; G., 2·2-2·4.

Hauyne.—Blue, rarely greenish; in small granular masses or rhomb. dodecahedrons, chiefly in lavas; H., 5-5·5; G., 2·4-2·5. B., sometimes decrepitates.

Wernerite or *Scapolite*.—Grey, greenish, reddish, &c.; in modified dimetric crystals, fibrous and lamellar masses, &c.; H., 5·5; G., 2·6-2·8. Easily fusible.

Obsidian, Pitchstone, &c. (more volcanic rocks, than simple minerals).—Grey, brown, black, green, &c.; massive, with conchoidal and sharp-edged fracture; H., 5-6; G., 2·5-2·7. Easily fusible.

Orthoclase or *Potash Feldspar.* White, red, green, &c.; in lamellar masses and oblique prisms, frequently in twin-forms. With quartz and mica it forms ordinary granite. H., 6; G., 2·5-2·6. Rather difficultly fusible.

Albite or *Soda Feldspar.*—Chiefly opaque white; in lamellar masses, and doubly oblique (or triclinic) prismatic forms; H., 6; G., 2·6-2·7. Rather difficultly fusible.

Wollastonite or *Tabular Spar.*—White, greenish, &c.; in pearly, fibrous or lamellar masses, or intermixed flat crystals; H., 5-5·5; G., 2·7-2-9. Easily fusible.

Iolite (Dichroite or *Cordierite).*—Dark blue, brownish or yellowish-grey in certain directions; in granular masses, and short, thick, many-sided prisms; H., 7-7·5; G., 2·6-2·8; Fuses with difficulty into a pale blue glass.

Emerald or *Beryl.*—Green, pale green, yellowish, blueish, colourless; in hexagonal prisms and columnar masses, rarely granular; H., 7·7-5-8. G., 2·6-2·8. Fuses with difficulty.

(*e*) SPECIFIC GRAVITY = 3 OR MORE.

(Chiefly silicates of alumina, lime, oxide of iron, &c.

Rhodonite (silicate of maganese). Rose-red, brownish; in lamellar masses; H., 5·5; G., 3·5-3·6. B., fusible into a black glass; a turquoise enamel with carb. soda.

Augite or *Pyroxene.*—Black, brown, green, colourless; in oblique prismatic crystals (mostly with two sloping planes at the summits), or in fibrous or granular masses; H., 5-6; G., 3·2-3·5. Easily fusible; the bead often magnetic. N. B. The light-coloured varieties are termed *Diopside,* &c.

Hornblende or *Amphibole.*—Brown, green, gray, colourless; &c.; in oblique prismatic crystals (usually prisms of four or six sides, with three planes at the summits), or in fibrous, acicular, or lamellar masses; H., 5-6; G., 3·0-3·4. Easily fusible; the dark glasses magnetic. N.B. The light-coloured varieties are termed *Tremolite;* the bright green, *Actynolite,* &c.

Idocrase.—Brown, green, yellow, &c.; in modified square prisms and pyramids, rarely in columnar or granular masses; H., 6·5-7·5; G., 3·3-3·5. Easily fusible; the dark glasses magnetic.

Garnet.—Red, brown, black (*melanite*), green, light-green

(*grossular*), yellow (*topazolite*), &c.; in rhombic dodecahedrons, trapezohedrons, and other monometric forms; also in granular and coarse lamellar masses; H., 6·5-7·5; G., 3·5-4·1. Easily fusible; the dark glasses, magnetic.

Epidote.—Green, brown, yellowish, grey (*zoizite*) &c.; in oblique prismatic crystals, columnar, fibrous, and granular masses; H., 6-7; G., 3·2-3·5. B., curls up into a dark ramified mass, which resists further fusion.

Schorl (black variety of *Tourmaline*).—Black; in three or nine-sided prisms longitudinally striated, or in acicular or columnar masses; H., 6·5-7; G., 3·1-3·3. Easily fusible with bubbling.

Sphene (silico-titanate of lime).—Brown, black, yellow, greenish, &c.; in sharp-edged oblique prisms, more rarely in lamellar masses. H., 5-5·5; G., 3·4-3·6. B., becomes yellow, and fuses on the edges with bubbling into a dark glass.

§ 2—*INFUSIBLE.*

(*a*) VERY EASILY DISSOLVED IN BORAX BEFORE THE BLOWPIPE, THE GLASS WITH SUFFICIENT QUANTITY BECOMING MILK-WHITE AND OPAQUE.

Apatite (phosphate of lime).—White, green, blueish, &c.; in hexagonal prisms, fibrous and globular masses; H., 5; G., 3·0-3·3.

Zinc Spar (carbonate of zinc).—White, brown, &c.; in aggregated rhombohedrons, often with curved faces, and also in botryoidal globular and granular masses; H., 5; G., 4·1-4·5.

Electric Calamine (silicate of zinc).—White, brown, yellowish, greenish, &c.; in closely aggregated prismatic and tabular forms, also in botryoidal and granular masses; H., 5; G., 3·3-3·5. Pyro-electric. B., sometimes decrepitates and intumesces slightly. Gives off water in the bulb-tube. The borax glass must be well saturated to become opaque. This and the preceding mineral are the chief "ores" of zinc.

(*b*) VERY SLOWLY SOLUBLE IN BORAX, THE GLASS NOT OPAQUE. SPECIFIC GRAVITY UNDER 3.

Leucite (silica, alumina, potash).—White, yellowish, grey; chiefly in trapezohedrons or little grains in lava; H., 5·5-6; G., 2·4-2·5.

Opal (hydrated silica).—Of all colours, sometimes colourless or yellowish, and exhibiting a beautiful irridescence; in amorphous, sharp-edged, or nodular pieces; H., 5·5-6·5; G., 2·0-2·2. B., becomes white and opaque; gives off a little water in the bulb tube.

N.B. Some of the *semi-opals* closely resemble obsidian or pitch-stone, from which, however, they may be distinguished by their infusibility.

Quartz (silica more or less pure).—Colourless, pink brown, violet, yellow, green, &c.,; in hexagonal prisms and pyramids (the planes of the former streaked across) and also in stalactitic, nodular, and amorphous masses; H., 7; G., 2·6-2·7. B., fusible with carb, soda (with effervescence) to a clear glass.

N. B. Rock Crystal, Amethyst, Calcedony, Cornelian, Chrysoprase, Jasper, Flint, Agate, &c., are merely varieties of Quartz, dependent upon colour and transparency.

Emerald and *Iolite*.—Fusible with difficulty. See Sec. 1. Page 17.

(c) LIKE (b) BUT SPECIFIC GRAVITY OVER 3·0.

Cassiterite or *Tinstone* (binoxide of tin).—Brown, &c., and sometimes colourless; in small square prisms and pyramids; also in rolled pebbles and granular masses; H., 6-7; G., 6·3-7·0. B., with carb. soda and borax on charcoal, yields globules of tin. Its high sp. gr. and great hardness, taken together, serve to distinguish it from all minerals of a similar aspect. It is the "ore" of tin.

Rutile (Titanic acid).—Red, brownish; lustre almost sub-metallic; in square prismatic crystals often "geniculated," more rarely in pebbles or massive, sometimes acicular in quartz; H., 6-6·5; G., 4·2-4·3. B., titanium reaction with borax.

Anatase (Titanic acid).—Light or dark brown, grey, indigo-blue; chiefly in small acute square-based pyramids; lustre inclining to sub-metallic; H., 5·5-6; G., 3·9-4; B., like Rutile.

Corundum (alumina, more or less pure).—Red, blue, green, grey, black, &c.; in hexagonal prisms and pyramids, and rolled pebbles; sometimes massive; H., 9; G., 3·9-4. Lustre of the dark varieties, more or less sub-metallic.

N.B. The true Ruby and Sapphire are red and blue Corundums. Adamantine spar is is a coarser variety. *Emery* is a

massive or granular grey or black Corundum, often mixed with magnetic iron ore.

Spinel (aluminate of magnesia, &c.).—Red, blueish, grey, dark-green, black, &c.; in small octahedrons (frequently twins) and in granular masses; H., 8; G., 3·5-4·9.

N.B. Gahnite or Automolite is a dark-green variety containing ox. of zinc, and Pleonaste a black variety containing iron.

The Diamond (pure carbon).—Colourless, red, brown, &c. &c.; in small octahedral and other monometric crystals, mostly with curved faces; H., 10; G., 3·5-3·6.

Zircon (silicate of zirconia).—Brown, grey, red, &c.; in square prisms and pyramids, and in rolled fragments; H., 7·5; G., 4·0-4·7.

Topaz (silica, alumina, fluorine).—Yellow, colourless, bluish, greenish, &c.; in rhombic prisms and pyramids, the former striated longitudinally, also in rolled pebbles and columnar masses; H., 8; G., 3·4-3·6· The crystals and pebbles when broken across show a laminar structure. B., intumesces slightly.

Tourmaline.—Most varieties (silicate of alumina, &c., containing boracic acid).—Brown, green, blue, red, colourless, &c. (The black variety, or "schorl," is fusible.) In 3 or 9-sided prisms longitudinally striated, also in columnar masses. H., 6·5-7·5; G., 3-3·3. Pyro-electric. B., occasionally, though rarely, fusible. The more deeply-coloured prisms, even in short pieces, are opaque longitudinally and translucent when viewed across. Rubellite is a red, Indicolite a blue, variety.

Staurolite (silicate of alumina and sesquiox. of iron).—Dark-red, brown, grey. In rhombic prisms (usually six-sided by the replacement of the two acute edges), and frequently in compound cruciform crystals. H., 7-7·5; G 3·5-3·8.

Andalusite (silicate of alumina).—Grey, red, greenish; in rectangular or rhombic prisms, granular and columnar masses; H., 7-7·5; G., 3·1-3·3. *Chiastolite*, in cruciformly-arranged prisms in clay-slate, is most probably a variety.

Cyanite or *Kyanite* (silicate of alumina).—Blue, grey, reddish, greenish, white, brownish, rarely black. In oblique prismatic crystals (sometimes closely associated with crystals of Stauro-

lite), but more commonly in laminar, bladed, and fibrous masses of a pearly-vitreous lustre. H., 5-7; G., 3·5-3·7.

Crysolite or *Olivine* (silicate of magnesia and protox. of iron. —Green, greenish-yellow, brownish, yellowish. Rarely in prismatic crystals, generally in little granular masses in basaltic and volcanic rocks. H., 6-7; G., 3·3-3·5.

B.—HARDNESS NOT SUFFICIENT TO SCRATCH ORDINARY WINDOW-GLASS.

§ 1—*SAPID. SOLUBLE IN WATER.*

(*a*) SULPHUR REACTION WITH CARB. SODA IN A REDUCING FLAME BEFORE THE BLOWPIPE.*

Alum (sulph. acid, al., potash, water.)—White, &c. In crusts, rarely in octahedrons. Taste, sweetish-astringent.

Epsomite (sulphate of magnesia.)—White; in crusts and acicular prisms. Bitter taste.

Sulphate of Zinc.—In white earthy crusts. Taste, metallic astringent.

Sulphate of Iron.—In pale green or greyish crusts and stalactitic masses. Taste, metallic astringent—like that of ink. B., a scoriform magnetic mass.

Sulphate of Copper.—Blue; in crusts, &c. Taste, metallic astringent. B., flame coloured green. If dissolved in a little water, the copper may be precipitated, as a red coating, on a bright knife-blade or polished piece of steel.

(*b*) NO SULPHUR REACTION WITH CA[illegible]DA.

Nitre (nitrate of potash.) In white crusts on the walls of caverns, &c. Taste, cooling and saline. B., flame coloured violet blue.

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*To detect sulphur, in any form, in mineral bodies, fuse a small quantity of the substance under examination with carb. soda on charcoal in a good reducing flame. Detach the fused mass, moisten it, and place it on a piece of bright silver, or on lead test-paper. [A coin or glazed visiting-card may be substituted for the purpose.] If sulphur be present, a yellowish, brown, or black stain will result.

Natron (carbonate of soda.) White, yellowish. In crusts, &c., on the dried-up beds and margins of certain lakes. Effervesces in acids. *Trona* is a kindred species, chiefly in doubly-oblique prisms and columnar masses.

Nitrate of Soda.—In white or grey crusts, and in large beds in Chili. Cooling saline taste. B., flame coloured yellow.

Sal Ammoniac (chloride of ammonium.)—In greyish crusts and globular masses, chiefly on volcanoes. Pungent saline taste. B., entirely vol.; chlorine reaction.*

Rock Salt (chloride of sodium.)—White, red, &c. In lamellar masses and cubical crystals. Strongly saline taste. B., often decrepitates; entirely vol.; chlorine reaction.*

§ 2—*TAKING FIRE AND BURNING IN THE FLAME OF A CANDLE.*

(*a*) A BITUMINOUS OR RESINOUS ODOUR EMITTED DURING BURNING.

Common Coal.—Black, more or less slaty; G., 1.25-1.35.

Brown Coal or *Lignite.*—Brown, often in ligneform masses, showing evident traces of woody structure; G., 1·15-1·3. *Jet* lies between common coal and brown coal.—Brownish-black; fracture conchoidal.

Bitumen (solid specimens.)—Black, brown, green. In nodular and stalactitic masses; fracture, conchoidal, vitreous; G., 1·0 and less. *Elaterite* is an elastic bitumen, soft and clammy.

Amber.—Yellow, greyish; in nodular masses, with resinous lustre; G., 1·08. Emits a peculiar aromatic odour whilst burning.

Various other fossil resins and bituminous matters belong to this division.

**Test for Chlorides.* If soluble, place a drop of the solution in contact with a fragment of sulphate of copper on a piece of clean silver; in a few minutes the silver will be stained yellowish-brown. If insoluble, add a portion to a bead of mic. salt coloured deep green by previous fusion with oxide of copper, and expose the whole on a loop of platinum wire to the blowpipe flame. The latter will assume a rich purple colour.

(b) A SULPHUROUS ODOUR EMITTED DURING BURNING. (THE FLAME COLOURED BLUE. ENTIRELY VOLATILIZABLE.

Sulphur.—Yellow of various shades, inclining to greenish and reddish-yellow; sk. very pale; lustre resinous; in acute rhombic octahedrons, crusts and granular masses; H., 1·5-2·5; G., 2·0-2·1.

Cinnabar (sulphide of mercury.)—Red, brownish; lustre inclining to sub-metallic; sk. scarlet-red; in minute rhombohedral crystals, granular, massive, and in crusts; H., 2-2·5; G., 8·0-8·2 (or only 6.7 in certain impure varieties of a brownish colour.) It is the principal "ore" of mercury.

(c) AN ALLIACEOUS ODOUR EMITTED DURING BURNING. (ENTIRELY VOLATILIZABLE.)

Orpiment (a sulphide of arsenic.)—Clear golden-yellow, paler in the streak; usually in laminar masses, sometimes in small prismatic crystals; sectile; flexible; H., 1·5-2; G., 3·4-3·5.

Realgar (a sulphide of arsenic.)—Orange-red; sk. orange-yellow; in oblique prismatic crystals, massive, and in grains; H., 1·5-2; G., 3·4-3·6; sectile.

§ 3—*NOT COMBUSTIBLE. YIELDING AN ALLIACEOUS ODOUR BEFORE THE BLOWPIPE.*

(a) B. A BUTTON OF SILVER OR LEAD.

Light Red Silver Ore (sulphur, arsenic, silver.)—Red; streak light red; usually in crystalline masses; H., 2-2·5; G., 5·4-5·6. B., decrepitates; yields a silver globule with evolution of arsenical fumes.

Mimetese (arseniate of lead oxide.)—Yellow, green, &c.; in curved hexagonal crystals and globular masses; H., 3·5-4; G., 7·2-7·3. B., is reduced.

(b) B., A MAGNETIC SCORIA.

Cube Ore (hydrous arseniate of iron oxides.)—Deep green, yellowish-brown; in groups of very small cubes, with, in general, the alternate angles truncated; H., 2·5; G., 2·9-3·0. B., yields a magnetic scoria.

Scorodite (hydrous arsen. of sesquioxide of iron.)—Pale green, brown; in druses of minute prismatic crystals; H., 3·5-4; G., 3·1-3·3. B., like cube ore.

(c) B. COPPER REACTION.

All the minerals of this subsection are hydrated arseniates of oxide of copper.

Olivenite.—Dark green, brownish; in groups of minute prismatic crystals and globular masses; H., 3; G., 3·9-4·4, B., deflagrates on charcoal, and yields a white metallic globule, which on cooling becomes covered with a red crust. Water, 3.5-4 per cent.

Aphanese.—Dark-green to dark-blue; in minute oblique prisms and radiated groups; H., 2·5-3; G., 4·2-4·4. B., deflagrates. Water, about 7.5 per cent.

Euchroite.—Fine green; in small prismatic crystals; H., 3·75; G., 3·39. B., deflagrates and is reduced. Water, 18-19 per cent.

Copper Froth.—Light-green to sky-blue; in reniform and radiated laminar masses; H., 1·5-2; G., 3·1. B., decrepitates. Water, about 18 per cent.

Copper Mica.—Rich emerald-green; chiefly in scaly or foliated masses; H., 2; G., 2·4-2·7. B., decrepitates and throws off scaly particles. Water, about 23 per cent.

Liroconite.—Sky-blue, light-green; in groups of small crystals; H., 2-2.5; G., 2·9-3·0. Water, about 25 per cent.

(d) NO METALLIC GLOBULE, SCORIA, OR COPPER REACTION.

Pharmacolite (arseniate of lime.)—White, greyish, sometimes pink from admixture of arseniate of cobalt; chiefly in crusts or fibrous crystals on arsenical ores. B., a white enamel. Water, about 24 per cent.

§ 4—*NO ALLIACEOUS ODOUR, &c. FUSIBLE. STREAK WHITE OR GREY.*

(a) YIELDING LEAD GLOBULES WITH SODA BEFORE THE BLOWPIPE.

Anglesite (sulphate of lead.)—White, dark-grey; in prismatic crystals and lamellar masses; H., 2·75-3; G., 6·2-6·3. B., generally decrepitates; fuses *per se* in the O. F. into a milk-white bead.

Cerusite (carbonate of lead.)—White, grey, &c.; in prismatic crystals, frequently stellated; also amorphous; H., 3-3·5;

G., 6·3-6·6. B., decrepitates, becomes yellow and red, and is reduced. Effervesces in diluted nitric acid.

Pyromorphite (phosphate of lead).—Green, brown, grey, yellowish; in curved hexagonal crystals, acicular groups, and botryoidal masses: H., 3·5-4: G., 6·5-7·0. B., not reduced *per se*, but fusing into a globule, which crystallises on cooling.

Tungstate of Lead.—White, yellowish, &c.; in modified square-based pyramids; H., 2·7-5-3; G., 7·8-8·2. B., with mic. salt in R. F., a fine blue glass.

Molybdate of Lead.—Yellow, green, greyish; in square prisms and pyramids; also amorphous; H., 2·75-3; G., 6·3-6·9. B., decrepitates, and is reduced; with mic. salt in R. F., a fine green glass.

(*b*) SULPHUR REACTION WITH SODA BEFORE THE BLOW-PIPE, BUT NO METALLIC GLOBULES.

Gypsum or *Selenite* (hydrated sulphate of lime).—White &c.; in pearly, fibrous, and lamellar masses, the laminæ flexible; also in oblique prismatic crystals; H., 1·5-2; G., 2·25-2·35. B., becomes opaque, exfoliates, and forms a white enamel. Water, about 21 per cent. [The properties of yielding to the nail, and becoming opaque in the flame of a candle, readily distinguish this important mineral. Deprived of its water, it constitutes "Plaster of Paris," so largely employed in the arts.]

Anhydrite (sulphate of lime).—White, greyish, chiefly in lamellar or granular masses. H., 3-3·5; G., 2·8-3·0. B., a white enamel.

Barytine (sulphate of baryta).—White, yellow, &c.; in prismatic crystals, globular, fibrous, and lamellar masses; H., 3-3·5; G., 4·3-4·7. B., decrepitates, and fuses to a white enamel, tinging the flame pale green.

Celestine (sulphate of strontia).—Pale-blue, white, &c.; in prismatic crystals, fibrous and lamellar masses; H., 3-3·5; G., 3·9-4·0. B., generally decrepitates, fuses, and imparts a red tint to the flame.

Websterite (sub-sulphate of alumina).—White, earthy, in nodular masses which adhere to the tongue; H., 1-2; G., 1·6-1·7. B., curls up, but does not fuse.

(c) NO METALIC GLOBULES, NOR SULPHUR REACTION WITH SODA BEFORE THE BLOWPIPE. YIELDING WATER IN THE BULB TUBE. [HYDRATED SILICATES.]

Fullers' Earth.—Greenish, grey, brown; in earthy masses, which receive a polish from the nail, and form a paste in boiling water. Fusible into a vesicular glass; water about 20 or 22 per cent.

*Stilbite**.—White, red, brown, &c.; in vitreo-pearly radiated and fibrous masses, prismatic and acicular crystals; H., 3·5-4; G., 2·1-2·2. Fusible, with previous intumescence; water, about 17 per cent.

Heulandite.—White, red, &c.; in vitreo-pearly radiated and fibrous masses; frequently also in oblique prismatic forms; H., 3·5-4; G., 2·1-2.2. B., like *Stilbite*. water, 14-16 per cent.

Chabasite.—White, pink, &c.; generally in groups of small vitreous rhombohedrons or six-sided pyramids; H., 4-4·5; G., 2·0-2.2. B., intumesces; water, 19-21 per cent.

Thomsonite and *Mesotype.*—Certain varieties. See A, Sec. 1 (*a*), p. 15.

Harmotome.—White, brownish, &c.; usually in small prismatic crystals; frequently in cruciform compound forms; H., 4·5; G., 2·4-2·5. Fuses quietly: water, about 14 per cent.

Phillipsite.—Like *Harmotome*, but intumesces before fusion.

Apophyllite.—White, &c.; vitreo-pearly; iridescent on cleavage faces; in square prismatic or pyramidal forms; H., 4·5-5; G., 2·3-2·4. B., fuses easily and with continued bubbling.

Chlorite (some varieties).—Dark green. In foliated and scaly masses; rarely in tabular hexagonal forms; H., 1-2; G., 2·7-3·0. Some specimens fuse readily, but others are infusible. Water, 12-13 per cent. Chlorite is a common ingredient of many crystalline rocks. [Chlorite Slate, &c.]

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* The remaining minerals (Chlorite excepted) of this sub-section, are most commonly found in association with trap or basaltic rocks. Apophyllite occurs also in certain metallic veins.

(*d*) NOT YIELDING METALLIC GLOBULES, &c., WITH SODA, NOR PRODUCING WATER IN THE BULB-TUBE.

Asbestus and *Amianthus* (varieties of augite or hornblende).—In silky fibrous masses. Colourless, or in various shades of green, grey, or brown. ["Mountain Leather" and "Rock Cork" are also varieties of augite, in the form of flexible lamellar masses resembling leather and cork.]

Lepidolite (lithia mica).—Pink, grey, red. In masses consisting of an aggregation of scaly particles. H., 2·5-3·5; G., 2·8-3·0. Very easily fusible, with great bubbling. The flame is coloured red.

Mica (certain varieties).—White, grey, green, brown, black, &c. In foliated masses and plates, splitting into the thinnest leaves. Also in tabular crystals. Flexible and elastic in thin pieces. H., 1·5-5·0, the latter on the edges of the folia. G., 2·7-3·1. Some varieties are fusible; others become opaque, but do not fuse.

N.B. The term "mica" includes at least six or seven foliaceous minerals of dissimilar crystallization and composition, but all more or less allied to one another (muscovite, margarodite, margarite, phlogopite, biotite, &c.). Mica enters into the composition of most granites.

Fluor Spar (fluoride of calcium).—Colourless, blue, green, yellow, violet, &c. Chiefly in cubes and cubical masses, the corners of which break off easily. H., 4; G., 3·1-3·2. B., decrepitates, fuses into a white enamel; the borax bead opaque by flaming. Fluor spar becomes phosphorescent when gently heated.

Witherite (carbonate of baryta).—Greenish-grey or colourless. Usually in globular masses with fibrous structure, or in prismatic forms. H., 3-4; G., 4·3. B., generally decrepitates; yields *per se* a white enamel, and an opaque bead with borax. The flame tinged pale green during fusion *per se*.

Strontianite (carbonate of strontia).—Green, grey, colourless. In fibrous and globular masses; also, in prismatic crystals. H., 3·5-4; G., 3·6-3·8. B., swells up into a white ramified mass, tinging the flame red. An opaque bead with borax.

§ 5.—*FUSIBLE OR REDUCIBLE. STREAK COLOURED.*

(*a*) STREAK RED.

Dark Red Silver Ore (an antimonial sulphur-salt of silver).—Dark, red, almost opaque, and with sub-metallic lustre. Chiefly in crystalline masses. H., 2·5; G., 5·8-5·9. B., decrepitates, gives off antimonial fumes, and yields a globule of silver. Sulphur reaction with soda.

Ruberite (red oxide of copper).—Deep red, lustre inclining to sub-metallic. Chiefly in small octahedrons, or amorphous. H., 3·5-4; G., 5·8-6·0. B., easily reducible, colouring the flame deep green.

Cinnabar.—Entirely volatilizable. G., 8·0. See § 2 (*b*).

(*b*) STREAK YELLOW.

Chromate of Lead.—Colour bright red; streak orange-yellow. In acicular groups of oblique prismatic crystals; also in flaky masses. H., 2·5-3; G., 5·9-6·1. B., decrepitates strongly, blackens, and is reduced.

Uranite (hydrous phosphate of sesqui-oxide of uranium).—Light yellow, chiefly in leafy masses or in square-prismatic tabular forms. H., 2-2·5; G., 3-3·2. Fusible into a black bead. Yields water in the bulb-tube.

(*c*) STREAK GREEN OR BLUE.

The minerals in this sub-section (vivianite excepted) impart a rich green colour to the blowpipe flame, and give the reactions of copper.

Malachite (carbonate of copper).—Fine green, paler in the streak. Chiefly in globular masses, with concentric lamellar and fibrous structure. H., 3·5-4; G., 3·7-4·0. B., easily fusible, and reducible to a button of copper. Yielding water in the bulb-tube. Effervesces in acids.

Azurite (blue carbonate of copper).—Rich blue, pale blue in the streak. Usually in groups of small oblique-prismatic crystals. H., 3·5-4; G., 3·7-3·9. B., like malachite. Effervesces in acids.

Copper Phosphates:—Rhenite, Libethenite, &c.—Green of various shades; paler in the streak. Chiefly in crystalline or fibrous groups; also, in prismatic and oblique-prismatic forms.

H., 4-5; G., 3·5-4·5. Easily fusible and reducible; yielding water in the bulb-tube.

Chalcolite (hydrous phosphate of the oxides of uranium and copper).—Rich emerald or deep green; paler in the streak. Chiefly in foliated or leafy masses; also, in square-prismatic tabular forms. H., 2-2·5; G., 3·5-3·6. Fusible into a black bead. Yielding water in the bulb-tube.

Vivianite (hydrous phosphate of iron).—Blue or green, streak very light blue, becoming darker on exposure. In acicular oblique-prismatic crystals, also in fibrous groups, and sometimes in earthy masses. H., 1·5-2; G., 2·6-2·7. Fusible into a magnetic scoria; frequently decrepitates; yields water in the bulb-tube.

§ 6—*INFUSIBLE. STREAK UNCOLOURED.*

(a) NOT YIELDING WATER IN THE BULB-TUBE.

Zinc Blende (sulphide of zinc).—Brown, yellow, red, greenish, black; streek white in the light coloured varieties, pale to dark-brown in the others; in lamellar masses and in crystals (chiefly hemihedral) of the regular or monometric system; H., 3·5-4; G., 4-4·2. B., generally decrepitates; sulphur reaction with carb. soda.

Apatite (phosphate of lime).—Scratches glass feebly; chiefly in hexagonal prisms. See A, Sec. 2, p. 18.

Calc Spar (carbonate of lime).—White, grey, &c., &c.; in rhombohedrons, hexagonal prisms, scalene dodecahedrons, &c.; also in globular, fibrous, and lamellar masses, readily yielding rhombohedrons by cleavage; H., 3; G., 2·5-2·8. Caustic after ignition. Easily soluble in borax; the saturated glass becomes opaque on cooling. Effervesces briskly in acids.

Arragonite (carbonate of lime).—White, grey yellow, blueish, &c.; in prismatic crystals, fibrous masses, globular and coralloidal forms; H., 3·5-4; G., 2·9-3; decrepitates gently in the flame of a candle, becoming white and opaque. Effervesces briskly in acids.

Dolomite (carbonate of lime and magnesia).—White, grey, brown, &c.; in rhombohedrons, mostly curved, and in cleavable lamellar masses; H., 3·5-4; G., 2·8-3·1. Effervesces feebly in cold acids. B., like Calc spar.

Siderose (carbonate of iron).—Brown, yellowish, green, grey,

&c.; chiefly in lamellar masses, or in groups of curved rhombohedrons; frequently also in nodular and botryoidal forms; H.. 3·5-4·5; G., 3·7-3·9. B., blackens and becomes magnetic. Effervesces feebly in cold acids.

Diallogite (carbonate of manganese).—Pale-red; in most varieties, becoming brown on exposure; chiefly in globular and granular masses, more rarely in rhombohedrons; H., 3·5-3·4. G., 3·5-3·7. B., decrepitates and turns black. Forms a turquoise enamel with carb. soda. Effervesces rather feebly in cold acids.

Tungstate of Lime.—White or yellowish; extremely heavy; in minute square-based pyramids, reniform and granular masses; H., 4-4·5; G., 6·0-6·1. B., decrepitates; with mic. salt in the R. F. forms a fine blue glass.

Mica—(some varieties).—Brown, green, white, grey, black, &c.; in tabular crystals and foliated masses, splitting into the thinnest leaves. See Sec. 4 (*d*), p. 27.

Talc and *Steatite.*—White, light-green, &c., sometimes mottled; chifly in foliated or compact masses, which are greasy to the touch; H., 1·0-2·0; G., 2·5-2·9; lustre, pearly in the foliated specimens; very sectile; flexible in thin leaves, but not elastic. Some varieties yield traces of water in the bulb-tube.

(*b*) YIELDING A CONSIDERABLE QUANTITY OF WATER IN THE BULB-TUBE.

Chlorite (certain varieties).—Dark-green; in foliated and scaly masses; rarely in tabular hexagonal forms; H., 1-2; G., 2·7-3·0. B., whitens and becomes opaque; some varieties are fusible; water, about 12 per cent. See also Sec. 4 (*c*), p. 26.

Serpentine (a silicate of magnesia, &c.).—Green, brown, red, grey, &c.; the colours often in veins, spots, and patches; chiefly amorphous; H., 2·5-3·5; G., 2·5-2·6. B., some varieties fuse on the thin edges, but most are infusible; water, about 12 or 14 per cent., occasionally higher.

Chrysocolla (hydrated silicate of copper).—Green, blueish; in compact amorphous masses; H., 2-4·5; G., 2·0-2·3. B., blackens; gives the reactions of copper; water, usually about 20 per cent.

Wavellite (hydrated phosphate of alumina).—In green or white radiated and botryoidal groups, mostly on clay-slate;

H., 3-4; G. about 2-3. B., becomes white and opaque, separating into infusible fibres, and tinging the flame pale green. Water, 24-28 per cent.

§ 7—*INFUSIBLE. STREAK COLOURED.*

Zinc Blende.—Streak pale brown in the dark varieties, otherwise white. B., sulphur reaction with carb. soda. See Sec. 6 (*a*,) p. 29.

Red Zinc Ore (oxide of zinc.)—Dull red, streak orange-yellow; usually in disseminated particles, or in granular masses; H., 4-4·5; G., 5·4-5·6; brittle. Owing to the presence of mangagese as an impurity, a turquoise enamel is obtained with soda before the blowpipe.

Earthy and Fibrous varieties of Red Iron Ore.—Red; streak, dull red; in amorphous and globular masses. B., become attractable by the magnet; fusible on the edges in the R. F

Earthy and Fibrous varieties of Brown Iron Ore. Brown, greyish-brown; streak, brownish-yellow; in amorphous and botryoidal masses. B., like red iron ore.

HARDNESS.

Scale of Möhs:

1. Talc.
2. Rock Salt.
3. Calcareous Spar.
4. Fluor Spar.
5. Apatite.
6. Feldspar.
7. Rock Crystal.
8. Topaz.
9. Corundum.
10. The Diamond.

Chapman's convenient scale, to correspond with that of Möhs:

1. Yields easily to the nail.

2. Does not yield to the nail. Does not scratch a copper coin.

3. Scratches a copper coin, but is also scratched by one, being of about the same degree of hardness.

4. Not scratched by a copper coin. Does not scratch glass [ordinary window glass.]

5. Scratches glass very feebly. Yields easily to the knife.

6. Scratches glass easily. Yields with difficulty to the knife.

7. Does not yield to the knife. Yields with difficulty to the edge of a file.

8, 9, 10. Harder than Quartz.

SPECIFIC GRAVITY.

Let a=the weight of the mineral in air.
w=the weight of the mineral in water.

Then the sp. gr. of the mineral=$\frac{a}{a-w}$.